

TITLE OF THE INVENTION

A SINGLE-PHASE KILOWATT-HOUR METER WITH CARD READER

BACKGROUND OF THE INVENTION

FIELD OF INVENTION

The invention relates to an electrical measuring instrument, in particular, to a single-phase kilowatt-hour meter (i.e. KWH meter) with Integrated Circuit (IC) card.

In accordance with the present invention, the electric measuring meter is a device used in recording the consumption of electricity consumed by consumers as the basis for collecting payment by the Power Supply Authority. The conventional KWH meter comprises an electromagnetic coil and a mechanical counter. Such device can only record the consumption of the electricity, but does not have the function of controlling the mode of electricity consumption. Therefore, it is not suitable for the purpose of "planned-consumption" of electricity nor for the convenient collection of payment by the Power Supply Authority.

In view of the drawbacks and/or limitations of the conventional measuring meter, several kinds of digital composite rate KWH meter have been developed. These meters employ IC cards (or magnetic card) and a microcomputer controlled measuring circuit. The cards are provided and sold by the Power Supply Authority as planned. The data of electricity quantity that is valid for the consumer is stored on the card. The measurement circuit records the consumed quantity of electricity. When the consumed quantity reaches that of the stored, the control circuit will cut off the power supply. Thus, the purpose of the "planned-consumption" of electricity and collection of payment is achieved.

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But the cost of these meters is higher than that of the traditional meters. On the other hand, if a cheaper digital meter is used in order to lower the cost of the device, the high precision of measurement cannot be attained.

Due to the above, the present invention provides a new kind of single phase composite rate KWH meter with IC card reader which is of low cost, high reliability and has the functions which are required for implementing the policy of "planned-consumption" of electricity and prepayment to the Power Supply Authority.

SUMMARY OF THE INVENTION

The KWH meter in accordance with the present invention comprises an induction type KWH meter and an electronic control circuit unit. The control circuit unit includes a CPU, an IC card reader, a clock and data-saving chip, a speaker, a display, a photo-electric sensor and a cut-off relay. The IC card reader, the data port and the clock port of clock and data-saving chip are connected to the two I/O ports of the CPU respectively. The output port of the CPU is connected to the speaker and the display. The photo-electric sensor is located at the rotating disc of the induction type KWH meter. The output of photo-electric sensor is connected to one of the interruption ports of the CPU. One of the output ports of the CPU is connected to the control end of the cut-off relay. The connection points of the cut-off relay are connected in series with the power supply circuit of the induction type KWH meter. A second interruption port of the CPU is connected to the function key. The power supply ends of the clock and the data-saving chip are connected to a standby battery. The serial communication port of the CPU is connected to the segment-data port of the display through the serial-parallel conversion chip. The I/O port of the CPU is connected to the bit-data port of the

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display.

When the IC card which is obtained from the Power Supply Authority is presented to the card reader by the consumer, the data of the prepaid quota of electricity bought by the consumer is stored in the data-saving chip. After this, the CPU will accumulate the data of power consumption as collected by the photo-electric sensor, and will update the data of remaining quota in the data-saving chip. When the remaining quota is less than the preset value, the CPU will actuate the speaker; and when the remaining quota of electricity becomes nil, the CPU will cut off the power supply circuit through the cut-off relay.

In accordance with the present invention, the new KWH meter has overcome the drawbacks of the conventional type of KWH meter and possesses the advantages as follows:

(I) as a result of fewer numbers of components used in the control circuit, and the mechanical counter of the induction type KWH meter being not required, the cost of the device is lower than those of the microcomputer controlled digital KWH meter;

(ii) as the record of electricity consumption is collected through the rotation of the rotating disc, the precision and reliability of the measurement is the same as that of the induction type KWH meter used;

(iii) by using the clock and data-saving chip, this meter can calculate the power consumption according to different composite fees and keep the necessary data safely for a long time; and

(iv) the consumers have to buy the card from Power Supply Authority, therefore the policy of "planned-consumption" of

electricity and prepayment to the Authority can be implemented.

BRIEF DESCRIPTION OF THE DRAWING

These and other advantages will become more apparent from the detailed description of the preferred embodiment along with the following drawings:

Fig. 1 is a block diagram of the control circuit in accordance with the present invention; and

Fig. 2 is the principle diagram of the control circuit unit in accordance with the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring to Fig. 1, this invention comprises an induction type KWH meter and a control circuit unit. The mechanical counter of the original KWH meter is omitted. In accordance with the present invention, the control circuit in the KWH meter 8 comprises a CPU 1, IC card reader 2, clock and data-saving chip 3, speaker 4, display 5, photo-electric sensor 6, and cut off relay 7. The IC card reader 2, the data port and clock port of clock and data-saving chip 3 are connected to the two I/O ports of the CPU 1 respectively. The output port of the CPU 1 is connected to the speaker 4 and the display 5. The photo-electric sensor 6 is located at the rotating disc of the induction type KWH meter 8. The output of the photo-electric sensor 6 is connected to one of the interruption port of the CPU 1. One of the output ports of the CPU 1 is connected to the control end of the cut-off relay 7. The connection point of the cut-off relay 7 is connected in series with the power supply circuit of the induction type KWH meter 8.

Referring to Fig.2, U1:uP denotes the high performance CPU; IC CARD denotes the IC card reader; U2:CLOCK denotes the clock and data-saving chip and can be formed into digital clock and data saving circuit with variable capacitance CV, resistance R1, diode D1, battery BATT and transistor T1. When the system is down, the Battery provides current to U2. U3:EEPROM denotes a data saving chip for calculated results used to permanently save the data of remaining KW-hrs. U4:SMART CARD denotes a card and driver. SPEAKER is an alarming device, which is controlled by P3.5 of the CPU. FUN.KEY provides a 6-digits LED digital numbers to display the control signal. LED1-LBD6 denotes the display indicator; OP denotes the photo-electric sensor; REL denotes the cut off relay; KEY denotes the function key; BAT denotes the standby battery; U5 denotes the serial-parallel conversion chip. The function KEY and standby battery BAT are designed to improve the capability of the unit.

The 220V AC source, being insulated by transformer TF, rectified by the rectifier BRIDGE and stabilized by the stabilizer 8705, is converted to the 5V DC power supply required by the control circuit. The photo-electric sensor OP is installed at the rotating disc of the induction type KWH meter. The output of which is connected to INTO (one of the interrupt ports of SCM U1). One end of the function KEY is connected to GROUND, and the other end is connected to another interrupt port INT1 of U1. The IC card reader (being shown as IC CARD in Fig. 2), the data port SDA and the clock port SCL of the clock and data-saving chip U2 are connected to the input output ports P1.0 and P1.1 (OC gate) respectively. As a result of the parallel connected data ports, the clock port is also connected in parallel. The chip selector port 1 of the IC CARD (IC card driver) is set at Low Level. The chip selector port 3 of data-saving chip U2 is set at High Level. Thus, U1 has different identify addresses for corresponding components. The power supply ends VCC of the clock and data-saving chip U2 are connected to the standby battery BAT. The input output

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port P3.7 of U1 is connected to Speaker through MC1413 driver U4. The input output port T1 (P3.5, used at I/O mode) of U1 is connected to the cut off relay REL through transistor T2. The serial display signal given by the serial ports RXD, TXD of U1 is converted to 8-digit parallel data signal Q0-Q7 through the serial-parallel conversion chip. Then, it is further connected to the segment data ports of the 6-digit display LED1-LED6 through eight transistors (not shown). The input output ports P1.2-P1.7 of U1 are connected to the bit-data ports of LED1-LED6 (digital display) respectively through the driver U4.

In accordance with the present invention, the principle of operation is as follows:

The IC card is inserted into the IC card reader (shown as IC CARD in the fig.) and the function key (KEY) is pressed to give the interrupt port INTI a signal and then proceeded to the INT1 interrupt program. The CPU acquires the information recorded on the IC card with serial mode and saves the information in the data-saving chip U2. Then, the CPU copies the invalid information onto the IC card. During the process of consuming the electricity, the rotating disc of the induction type KWH meter rotates. A mark on the rotating disc passes over the photo-electric sensor OP. The sensor OP produces an electric pulse signal SIG to the CPU. Firstly, the CPU calculates on the accumulated pulses, that is, to calculate the consumed quantity of electricity, and then retrieve the information of date and time etc. from the data-saving chip U2, and calculates the remaining quota according to different time-band (time period) and fee-rate. Secondly, the CPU sends the data of both the consumed quota and the remaining quota back to the data-saving chip U2. Normally, the data-saving chip U2 is supplied by the 5V DC source. In case the power supply system is interrupted temporarily, the battery BAT will supply power for the data-saving chip through diode D2 to protect the data in RAM from loss. When the remaining quota of electricity is not enough, the CPU will

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produce a signal through its P3.7 port, and actuate the SPEAKER to give an alarm to the consumer. The alarm could be stopped by pressing the function KEY. In case the prepaid quota of electricity is finished, CPU will send out a RELY signal (Low Level) through P3.4 port, and actuate the relay REL through the transistor T2 to cut off the power supply.

If the IC card is not presented or is invalid, and the KEY is pressed, the serial ports and the input output ports P1.2~P1.7 of the CPU will light up the 6 digits of the LED indicator in turn and display the data of remaining quota, total quantity of electricity consumed, current date and time, starting and ending time of multi-time-band, composite fee etc. page by page.

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CLAIMS

1. A Kilowatt-Hour (KWH) meter with card reader comprising an induction type KWH meter and an electronic control circuit characterized in that said control circuit unit includes a CPU, IC card reader, clock and data-saving chip, speaker, display, photo-electric sensor and cut-off relay being connected in series with a power supply, wherein the IC card reader, the data port and clock port of clock and data-saving chip are connected to the two I/O ports of CPU respectively; the output port of CPU is connected to said speaker and said display; the photoelectric sensor is located at a rotating disc of an induction type KWH meter and the output of the photo-electric sensor is connected to one of the interruption ports of the CPU; one of the output ports of the CPU is connected to the control port of the cut-off relay; and the connection points of cut-off relay are connected in series with the power supply circuit of the induction type KWH meter.
2. The Kilowatt-Hour (KWH) meter as set forth in Claim 1, wherein the other interruption port of CPU is connected to the function key; and the power supply ports of the clock and data-saving chip are connected to a standby battery.
3. The Kilowatt-Hour (KWH) meter as set forth in Claim 1, wherein the serial communication port of the CPU is connected to a segment-data port of the display through the serial-parallel conversion chip and the I/O ports of CPU are connected to the bit-data port of the display.
4. The Kilowatt-Hour (KWH) meter as set forth in Claims 1, 2 or 3, wherein the control circuit unit also comprises a CPU-reset and an anti-dead-halt circuit, being formed by a timer and a

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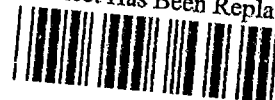
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transistor, and the output port of timer is connected to the reset port of the CPU.

5. The Kilowatt-Hour (KWH) meter as set forth in Claims 1, 2, 3 or 4, wherein the I/O ports of the CPU is connected to the input of the transistor, and the output of the transistor is connected to the input port of the timer.

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A SINGLE-PHASE KILOWATT-HOUR METER WITH CARD READER**ABSTRACT OF DISCLOSURE**

A single-phase Kilometer-Hour (KWH) meter with card reader comprising an induction type KWH meter and an electronic control circuit unit is disclosed. The control circuit unit comprises a CPU, an IC card reader, a clock and data-saving chip, a speaker, a display, a photo-electric sensor and a cut-off relay which is connected in series with the power supply. The IC card reader, the data port and clock port of clock and data-saving chip are connected to the two I/O ports of the CPU respectively.

(FIGURE 2 IS SUGGESTED FOR PUBLICATION)

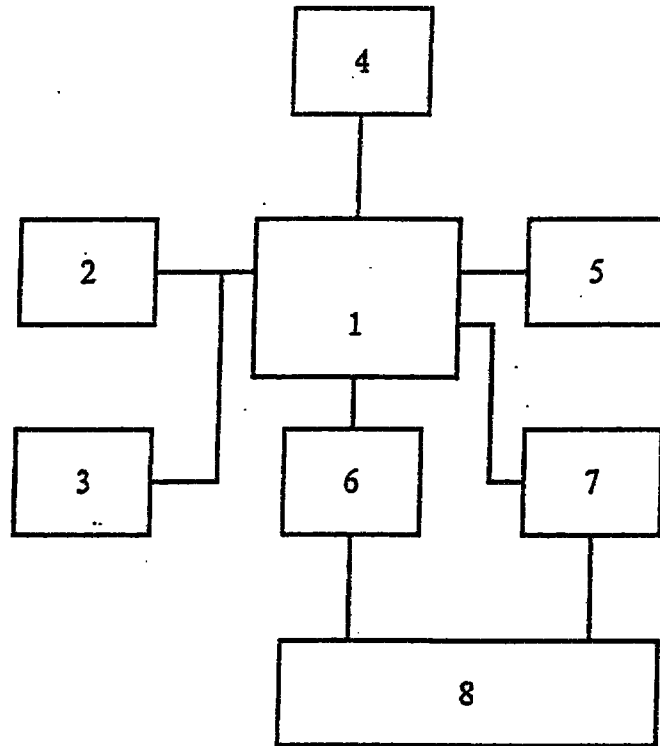


FIG 1

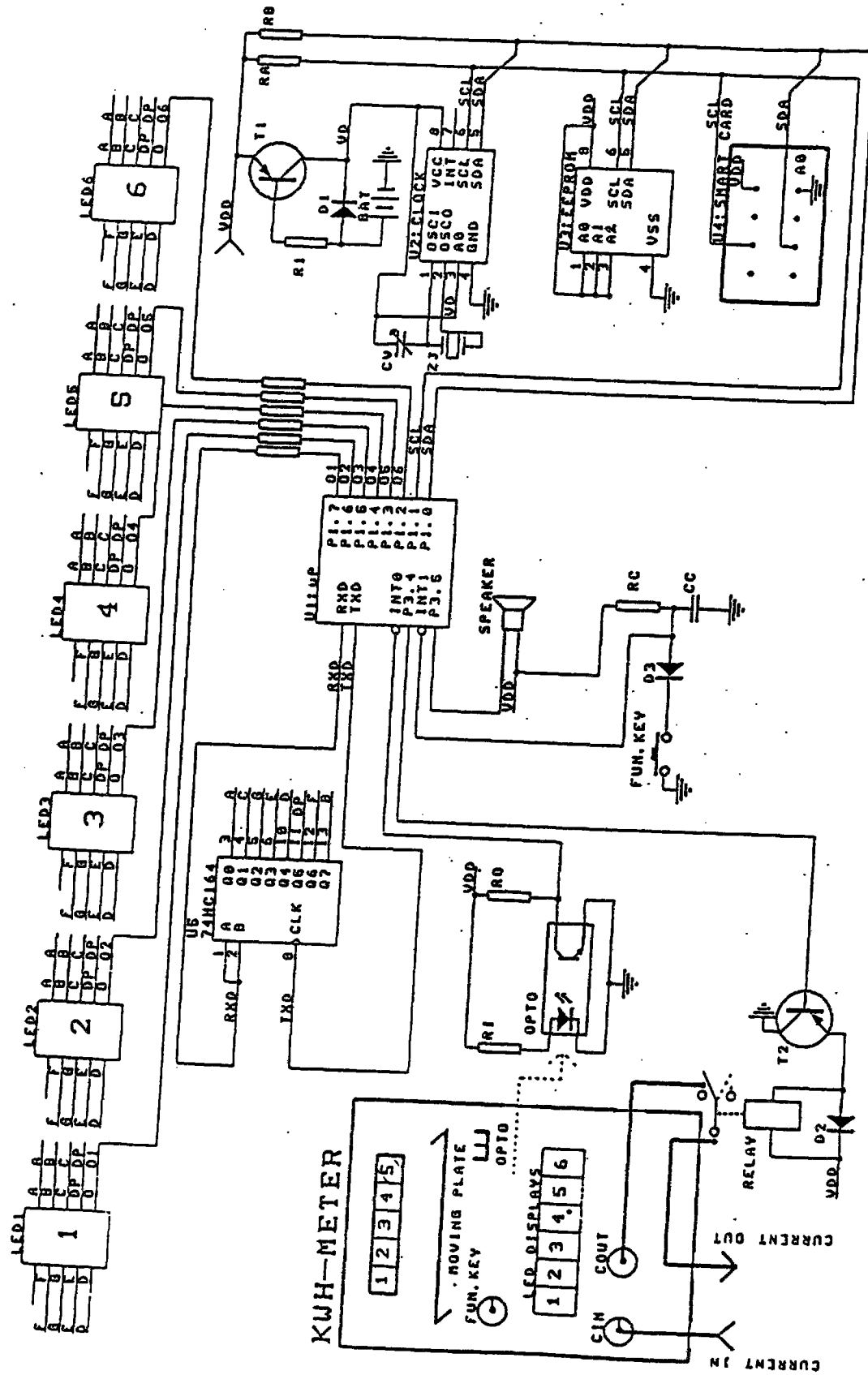
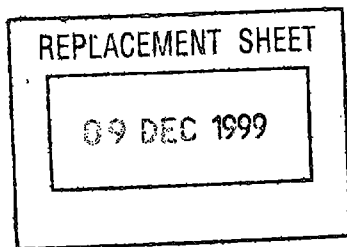


FIG 2



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CLAIMS



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1. A Kilowatt-Hour (KWH) meter with card reader comprising an induction type KWH meter and an electronic control circuit, characterized in that said control circuit includes a CPU, IC card reader, clock and data-saving chip, speaker, display, photo-electric sensor and cut-off relay being connected in series with a power supply, wherein the IC card reader, the data port and clock port of said clock and data-saving chip are connected to two I/O ports of CPU respectively; the output port of CPU is connected to said speaker and said display; said photo-electric sensor is located at a rotating disc of the induction type KWH meter and an output of the photo-electric is connected to one of the interruption ports of CPU; one of the output ports of CPU is connected to the control of said cut-off relay and said control circuit further includes a CPU-reset and an anti-dead-halt circuit having a timer and a transistor; and the connection points of said cut-off relay are connected in series with a power supply circuit of said induction type KWH meter.
2. The Kilowatt-Hour (KWH) meter as set forth in Claim 1, wherein the other interruption port of CPU is connected to the function key; and the power supply ports of the clock and data-saving chip are connected to a standby battery.
3. The Kilowatt-Hour (KWH) meter as set forth in Claim 1, wherein the serial communication port of the CPU is connected to a segment-data port of the display through the serial-parallel conversion chip and the I/O ports of CPU are connected to the bit-data port of the display.

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4. The Kilowatt-Hour (KWH) meter as set forth in Claims 1, 2 or 3, wherein the I/O ports of the CPU is connected to the input of the transistor, and the output of the transistor is connected to the input port of the timer.

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But the cost of these meters is higher than that of the traditional meters. On the other hand, if a cheaper digital meter is used in order to lower the cost of the device, the function of calculating the power consumption in different composite fees cannot be attained.

Due to the above, the present invention provides a new kind of single phase composite rate KWH meter with IC card reader which is of low cost, high reliability and has the functions which are required for implementing the policy of "planned-consumption" of electricity and prepayment to the Power Supply Authority.

SUMMARY OF THE INVENTION

The KWH meter in accordance with the present invention comprises an induction type KWH meter and an electronic control circuit unit. The control unit mainly comprises a special I²C Bus which connects to the following four units respectively with a data line SDA and a clock line SCL: a microprocessor CPU, a CARD reader, a Clock and Data Saving IC chip and an EEPROM chip for saving date permanently. The control unit also comprises a photoelectric sensor, a cut-off relay a display and a speaker. The output port of the CPU is connected to the speaker and the display. The photo-electric sensor is located at the rotating disc of the induction type KWH meter. The output of photo-electric sensor is connected to one of the interruption ports of the CPU. One of the output ports of the CPU is connected to the control end of the cut-off relay. The connection points of the cut off relay are connected in series with the power supply circuit of the induction type KWH meter. A second interruption port of the CPU is connected to the function key. The power supply ends of the clock and the data-saving chip are connected to a standby battery. The serial communication port of the CPU is connected to the segment-data port of the display through the serial-parallel conversion chip. The I/O port of the CPU is connected to the bit-data port of the

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display.

When the IC card which is obtained from the Power Supply Authority is presented to the card reader by the consumer, the data of the prepaid quota of electricity bought by the consumer is stored in the data-saving chip. After this, the CPU will accumulate the data of power consumption as collected by the photo-electric sensor, and will update the data of remaining quota in the data-saving chip. When the remaining quota is less than the preset value, the CPU will actuate the speaker; and when the remaining quota of electricity becomes nil, the CPU will cut off the power supply circuit through the cut-off relay.

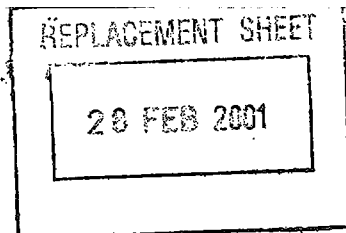
In accordance with the present invention, the new KWH meter has overcome the drawbacks of the conventional type of KWH meter and possesses the advantages as follows:

(I) as a result of fewer numbers of components used in the control circuit, and the mechanical counter of the induction type KWH meter being not necessary, the cost of the device is lower than those of the microcomputer controlled digital KWH meter;

(II) as the record of electricity consumption is collected through the rotation of the rotating disc, the precision and reliability of the measurement is the same as that of the induction type KWH meter used;

(III) by using the clock and data-saving chip, this meter can calculate the power consumption according to different composite fees and keep the necessary data safely for a long time; and

(IV) the consumers have to buy the card from Power Supply Authority, therefore the policy of "planned-consumption" of



port P3.5 of U1 is connected to speaker directly. The output port P3.4 of U1 is connected to the cut off relay REL through transistor T2. The serial display signal given by the serial ports RXD, TXD of U1 is converted to 8-digit parallel data signal Q0-Q7 through the serial-parallel conversion chip. Then, it is further connected to the segment data ports of the 6-digit display LED1-LED6 through eight transistors (not shown). The input output ports P1.2-P1.7 of U1 are connected to the bit-data ports of LED1-LED6 (digital display) respectively.

In accordance with the present invention, the principle of operation is as follows:

The IC card is inserted into the IC card reader (shown as IC Card in the fig.) and the function key (KEY) is pressed to give the interrupt port INT1 a signal and then proceeded to the INT1 interrupt program. The CPU acquires the information recorded on the IC card with serial mode and saves the information in the data-saving chip U2. Then, the CPU copies the invalid information onto the IC card. During the process of consuming the electricity, the rotating disc of the induction type KWH meter rotates. A mark on the rotating disc passes over the photo-electric sensor OP. The sensor OP produces an electric pulse signal SIG to the CPU. Firstly, the CPU calculates on the accumulated pulses, that is, to calculate the consumed quantity of electricity, and then retrieve the information of date and time etc. from the data-saving chip U2, and calculates the remaining quota according to different time-band (time period) and fee-rate. Secondly, the CPU sends the data of both the consumed quota and the remaining quota back to the data-saving chip U2. Normally, the data-saving chip U2 is supplied by the 5V DC source. In case the power supply system is interrupted temporarily, the battery BAT will supply power for the data-saving chip through diode D1 to protect the data in RAM from loss. When the remaining quota of electricity is not enough, the CPU will

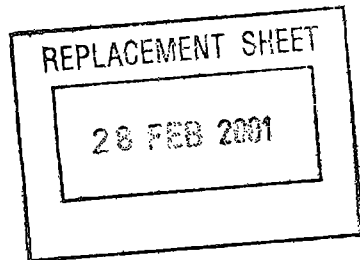
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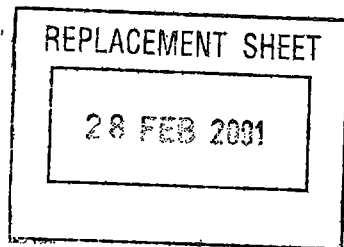
produce a signal through its P3.5 port, and actuate the SPEAKER to give an alarm to the consumer. The alarm could be stopped by pressing the function KEY. In case the prepaid quota of electricity is finished, CPU will send out a RELY signal (Low Level) through P3.4 port, and actuate the relay REL through the transistor T2 to cut off the power supply.

If the IC card is not presented or is invalid, and the KEY is pressed, the serial ports and the input output ports P1.2-P1.7 of the CPU will light up the 6 digits of the LED indicator in turn and display the data of remaining quota, total quantity of electricity consumed, current date and time, starting and ending time of multi-time-band, composite fee etc. page by page.



CLAIMS

1. A Kilowatt-Hour (KWH) meter with card reader comprising an induction type KWH meter (8) and an electronic control circuit, characterized in that said control circuit includes a CPU (1), IC card reader (2), clock and data-saving chip (3), speaker (4), display (5), photo-electric sensor (6) and cut-off relay (7) being connected in series with a power supply, wherein the IC card reader (2), the data port and clock port of said clock and data-saving chip (3) are connected to two I/O ports of CPU respectively; the output port of CPU (1) is connected to said speaker (4) and said display (5); said photo-electric sensor (6) is located at a rotating disc of the induction type KWH meter (8) and an output of the photo-electric sensor (6) is connected to one of the interruption ports of CPU (1); one of the output ports of CPU (1) is connected to the control of said cut-off relay (7) and said control circuit further includes a CPU-reset and an anti-dead-halt circuit having a timer and a transistor; and the connection points of said cut-off relay (7) are connected in series with a power supply circuit of said induction type KWH meter (8).
2. The Kilowatt-Hour (KWH) meter as set forth in Claim 1, wherein the other interruption port of CPU (1) is connected to the function key; and the power supply ports of the clock and data-saving chip (3) are connected to a standby battery.
3. The Kilowatt-Hour (KWH) meter as set forth in Claim 1, wherein the serial communication port of the CPU (1) is connected to a segment-data port of the display (5) through the serial-parallel conversion chip and the I/O ports of CPU (1) are connected to the bit-data port of the display (5).



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4. The Kilowatt-Hour (KWH) meter as set forth in Claims 1, 2, or 3, wherein the I/O ports of the CPU (1) is connected to the input of the transistor, and the output of the transistor is connected to the input port of the timer.